AF/2882

Navy Case No. 82,530

In the United States Patent and Trademark Office

In re: Kafafi et al
Serial No.: 09/995,736
Filed: Nov. 29, 2001
For: A Universal Host For RG OR RGB Emission In Organic Light Emitting Devices

Examiner: Elizabeth M. Keaney
Art Unit: 2882

Date: June 14, 2004

Appeal Brief

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20230:

Sir:

This is an appeal from the final rejection dated Nov. 19,2004, of claims 1-55. Following submission of Declaration Under 37 CFR 1.131(a), the Picciolo and the Lin references have been antedated, thus rendering claims 4,6,8,9,19,23,24,32,36,37,44,46,48 and 49 allowable and leaving claims 1-3,5,7,10-18,20-22,25-31,33-35,38,38-43,45,47,50 and 51 under the final rejection. Since of appeal of claims 50-55 is not being pursued, the appealed claims are 1-3,5,7,10-18,20-22,25-31,33-35,38-43,45 and 44 and allowable claims are believed to be claims 4,6,8,9,19,23,24,32,36,37,44,46,48 and 49. The allowable claims are presented in rewritten and independent form at the end of the Appendix section of this Appeal Brief.

(1) Real Party in Interest

The real party in interest herein is the U.S. Government, as represented the the Secretary of the Navy.

(2) Related Appeals and Interferences

This patent application is not involved in any other appeal or interference.

(3) Status of Claims

Appealed claims are claims 1-3,5,7,10-18,20-22,25-31,33-35,38-43,45 and allowable claims are believed to be claims 4,6,8,9,19,23,24,32,36,37,44,46,48, 49.

(4) Status of Amendments

The only amendment after final rejection is the amendment entitled "Amendment After Final Rejection" dated March 12,2004, has been entered but did not place the application in condition for allowance because the limitation "a universal host that can be used for red, green and blue dopants' fails to positively recite a structure capable of supporting red, green and blue dopants for a full color display, see item #5 of the Advisory Action dated April 23, 2004.

(5) Summary of Invention

The appealed claims are directed to an organic light emitting diode wherein one organic material serves as the universal host for red (R), green (G) and blue (B) dopants (p.4, lines 14-15 of the specification). An example of the universal host is BMB-2T or 5,5' - bis(dimesitylboryl) - 2,2' - bithiophene (p.6, l. 9 of the specification); an example of the red dopant is DPP or 6,13 - diphenylpentacene; an example of the green dopant is DEQ or N,N' - diethylquinacridone (p.6, l. 10-11 of the specification; and an example of the blue dopant is NNPB or 4,4 - bis (1 - naphthylphenylamino) diphenyl (p.6, l.13 of the specification) although BMB-2T can be used as a blue emitting material without any dopant (p.6, l.11-12 of the specification). The universal host is a material that is either transparent in the visible region or may be emissive in the blue region when used additionally as the blue emitting species and/or possesses carrier properties (p.4, lines 26-28 of the specification).

(6) Issues

(a) Whether claims 1,16,29 and 42 are indefinite for failing to particularly point out distinctly claim the subject matter which Applicants regard as their invention.

(b) Whether claims 1-3,5,7 and 10-13 are anticipated by the Takahashi reference under 35 USC 102 (e).

(c) Whether claims 16-18,20,22,25-31,33,35,38-43,45 and 47 are anticipated under 35 USC 102 (a) by the Borner reference.

(d) Whether claims 4 and 9 are unpatentable under 35 USC 103 (a) over the Takahashi in view of the Picciolo references.

(e) Whether claim 6 is unpatentable under 35 USC 103 (a) over the Takahashi in view of the Picciolo and the Xie references.

(f) Whether claim 8 is unpatentable under 35 USC 103 (a) over the Takahashi in view of the Lin references.

(g) Whether claims 14 and 15 are unpatentable under 35 USC 103 (a) over the Takahashi in view of the Baldo references.

(h) Whether claims 19,24,32,37,44 and 49 are unpatentable presumably under 35 USC 103 (a) over the Borner in view of the Picciolo references.

(i) Whether claims 21 and 34 are unpatentable under 35 USC 103 (a) over the Borner in view of the Xie references.

(j) Whether claims 23,36 and 48 are unpatentable under 35 USC 103 (a) over the Borner in view of the Lin references.

(k) Whether claim 46 is unpatentable under 35 USC 103 (a) over the Borner in view of the Picciolo and the Xie references.

(7) Grouping of Claims

All of the claims on appeal either stand or fall together.

(8) Argument

This section of the Appeal Brief is divided into sub-paragraphs directed to specific types of rejections. Sub-paragraph (i) is directed to indefiniteness rejections and objections based on 35 USC 112; sub-paragraphs (ii) are directed to anticipation rejections under 35 USC 102; and sub-paragraphs (iii) are directed to unobvious rejections based on 35 USC 103.

(i) This is in reference to the objection of claims 1,16,29 and 42 as being indefinite for failing to particularly point out and distinctly claims the subject matter which Applicants regard as their invention, presumably under the second paragraph of 35 USC 112. The Examiner contends that the limitation "a single universal host that can be ..." is ambiguous as to whether the host just has the ability to be used with all three colors but the three colors are not implemented in the host. Antecedent basis for the objected limitation appears on p. 3 in lines 28-29 of the specification, to wit,

"... A single universal host can be used for R, G and B dopants ..."

It should be apparent that the host can be used for any of the dopants singly of in combination. In this regard, it is believed that certain parts of the disclosure shed light on this aspect of the invention, such the following, which appears on p.3 in lines 22-23 of the specification:

"... A new feature of this invention is the use of a universal host for RGB dopants for achieve full color displays using OLEDs..."

In this connection, the figures also support the limitation in that the host can be used for one, two or three dopants. The Examiner is invited to suggest language which would overcome

this objection.

(ii)(A) Claims 1-3,5,7 and 10-13 stand finally rejected as being anticipated by the Takahashi reference. The Examiner contends that in Fig. 5 of the Takahashi reference, and throughout its disclosure, the Takahashi reference discloses an organic light emitting diode comprising a single universal host that can be used for red, green and blue dopants for full color display. Applicants beg to differ. The Takahashi reference does not disclose a single universal host that can be used for red, green and blue dopants for full color display since as of the filing date of the Takahashi patent application, i.e., Aug. 29, 1996, no such universal host was known, as can be verified by persons skilled in this art. Discussion of the Takahashi reference in connection with the universal host appears in (iii)(A), below.

(ii)(B) Claims 16-18,20,22,25-31,35,38-43,45 and 47 stand finally rejected as being anticipated by the Borner reference. The Examiner contends that in Fig. 1, and throughout its disclosure, the Borner reference discloses an OLE comprising a single universa host that can be used for red, green and blue dopants. The claims are not anticipated by the Borner reference since the Borner reference does not disclose a single universal host that can be used for red, green and blue dopants since as of the filing date of the Borner patent application, i.e., Aug. 11, 1994, no such universal host was known, as can be verified by persons skilled in this art. Discussion of the Borner reference in connection with the universal host appears in (iii)(A), below.

(iii)(A) Claims 4 and 9 stand finally rejected as being unpatentable over the Takahashi in view of the Picciolo references. It is believed that this rejection has been overcome by antedating the Picciolo reference and the fact that the Takahashi reference does not disclose nor suggest the universal host. The Takahashi reference discloses an electroluminescent (EL) device in Fig. 5

and describes it at top of col. 18 thereof. Reference numeral 13 is a glass substrate, 12 is an anode, 14 is a luminous layer (host), 15 is an HTL and 16 is an ETL. Where is the universal host in the Takahashi reference ? On p.3 of the specification, it is noted that a new feature of the invention disclosed and claimed herein is the universal host for RGB dopants to achieve full color displays. A single universal host can be used for RGB dopants and if the universal host has blue emmissive properties, the blue dopant can be omitted; and if the universal host has carrier transport properties, the additional hole or electron transport materials can also be omitted. The universal host also makes possible the combination of the energy transfer mechanism and the direct carrier recombination mechanism for RGB emission. As noted at bottom of p.4 of the specification,

> "By dispersing the dopants in the universal host, efficient energy transfer from host to guest and/or direct carrier recombination on the dopant takes place resulting in bright red, green or blue emission, depending on the dopant"

The Takahashi reference discloses an EL device using one dopant and a luminous layer that serves as the host. The Takahashi reference neither discloses nor suggests the universal host that leads to RGB emission.

(iii)(B) Claim 6 stands finally rejected as being unpatentable over the Takahashi in view of the Picciolo and the Xie references. For reasons given in (iii)(A), above, the Takahashi reference does not disclose nor suggest the universal host and the Picciolo reference has been antedated and is no longer applicable since it is not prior art.

(iii)(C) Final rejection of claim 8 as being unpatentable over the Takahashi in view of the Lin references should be withdrawn and the claim allowed due to the fact that the combination

of the references does not render obvious its claimed subject matter since the Takahashi reference does neither disclose nor suggest the universal host, for reasons noted in (iii)(A), above, and the fact that the Lin reference has been antedated and no longer is a prior art reference.

(iii)(D) Final rejection of claims 14 and 15 as being unpatentable over the Takahashi in view of the Baldo references should be withdrawn and the claims allowed since the combination of the applied references does not render these claims obvious due to the fact that the Takahashi reference neither discloses nor suggests the universal host, as more fully discussed in (iii)(A), above.

(iii)(E) Final rejection of claims 19,24,32,37,44 and 49 as being unpatentable over the Borner in view of the Picciolo should be withdrawn and the claims allowed for the reasons that the Borner reference neither discloses nor suggests the universal host and the Picciolo reference has been antedated and is no longer a prior art reference. The Borner reference, like the Takahashi reference, neither discloses nor suggests the universal host disclosed and claimed herein. A universal host can be doped by oner or more materials giving rise to RGB emission. The fact that a host can be doped by several dopants does not mean that it will lead to RGB emission and a multiple number of dopants can produce only one color, however, a universal host can produce RGB emission which can produce a full color display. In EL display devices, the primary colors are red, green and blue, so, unless RGB emission can be produced, a full color display device cannot be made. As already noted, the Borner reference does not disclose nor suggest the universal host and there is no mention of the red, green and blue dopants. The fact that use of several complexes is disclosed, see line 32 in col. 4 of the Borner reference, does not mean that the host is a universal host or that RGB emission can be obtained.

(iii)(F) Final rejection of claims 21 and 34 as being unpatentable over the Borner in view of the Xie references should be withdrawn and the claims allowed due to the fact that the Borner reference does not disclose nor suggest the universal host, as discussed in (iii)(E), above.

(iii)(G) Final rejection of claims 23,36 and 49 as being unpatentable over the Borner in view of the Lin references should be withdrawn and the claims allowed for the reasdons that the Borner reference neither discloses nor suggests the universal host, as discussed in (iii)(E), above, and the Lin reference has been antedated and is no longer a prior art reference.

(iii)(H) Final rejection of claim 46 as being unpatentable over the Borner in view of the Picciolo and the Xie references should be withdrawn and the claim allowed for the reasons that the Borner reference neither discloses nor suggests the universal host, as discussed in (iii)(E), above, and the Picciolo reference has been antedated.

Reversal of the final rejection is requested for the reason that the primary references do not disclose the universal host. It is believed that on reversal of the final rejection, this patent application will be in condition for allowance.

It is petitioned to extend the time for filing this Appeal Brief for one month to June 12, 2004. Please charge the time extension fee of $130.00, of whatever is applicable, to our account #50-0281.

Sincerely,

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(9) Appendix

The following finally rejected claims are on appeal:

1. An organic light emitting diode (OLED), comprising:

a single universal host that can be used for red, green and blue dopants for full color display, as specified by the CIE for red, green and blue dopants ;

a hole transporting layer;

an electron transport layer;

wherein said hole transporting layer and said electron transport layer are on opposing sides of said universal host and are in electrical contact with said universal host;

wherein said universal host comprises an active emitting layer of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active portion; wherein at least one of said electrodes is transparent.

2 . The OLED of claim 1, wherein said universal host is a material adapted to emit at wavelengths in the blue visible light region or shorter.

3. The OLED of claim 1, wherein said universal host is doped with a red emitting material.

5. The OLED of claim 1, wherein said universal host is doped with a green emitting material.

7. The OLED of claim 1, wherein said universal host is doped with a blue emitting material.

10. The OLED of claim 1, wherein at least one of said transparent electrodes comprises a glass substrate coated with a transparent anode material.

11. The OLED of claim 10, wherein said transparent anode material is indium tin oxide.

12. The OLED of claim 1, wherein one of said electrodes comprises a metallic cathode.

13. The OLED of claim 12 , wherein said metallic cathode comprises an alloy of Mg and Ag.

14. The OLED of claim 1, wherein a hole blocking layer is inserted between said universal host and said electron transport layer, and wherein said hole blocking layer, said hole transporting layer, and said electron transport layer are in electrical contact with said universal host;

15. The OLED of claim 14 , wherein said hole blocking layer comprises bathocuproine.

16. An organic light emitting diode (OLED), comprising:

a hole transporting layer ;

an electron transport layer that is also a single universal host that can be used for red, green and blue dopants ;

wherein said hole transporting layer and said electron transport layer are placed in series and are in electrical contact with each other; wherein said hole transporting layer and said electron transport layer together comprise an active portion of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active portion; wherein at least one of said electrodes is transparent.

17. The OLED of claim 16, wherein said electron transport layer is a material adapted to emit at wavelengths in the blue visible light region or shorter.

18. The OLED of claim 16, wherein said electron transport layer is doped with a red emitting material.

20. The OLED of claim 16, wherein said electron transport layer is doped with a green emitting material.

21. The OLED of claim 20, wherein said green emitting material is N,N' - diethylquacridone.

22. The OLED of claim 16, wherein said electron transport layer is doped with a blue emitting material.

25. The OLED of claim 16, wherein at least one of said transparent electrodes comprises a glass substrate coated with a transparent anode material.

26. The OLED of claim 25, wherein said transparent anode material is indium tin oxide.

29. An organic light emitting diode (OLED), comprising:

a hole transporting layer that is also a single universal host that can be used for red, green and blue dopants ;

an electron transport layer;

wherein said hole transporting layer and said electron transport layer are placed in series and are in electrical contact with each other; wherein said hole transporting layer and said electron transport layer together comprise an active portion of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active portion; wherein at least one of said electrodes is transparent.

30. The OLED of claim 29, wherein said hole transporting layer is a material adapted to emit at wavelengths in the blue visible light region or shorter.

31. The OLED of claim 29, wherein said hole transporting layer is doped with a red emitting material.

33. The OLED of claim 29, wherein said hole transporting layer is doped with a green emitting material.

34. The OLED of claim 33, wherein said green emitting material is N,N'-diethylquinacridone.

35. The OLED of claim 29, wherein said hole transporting layer is doped with a blue emitting material.

38. The OLED of claim 29, wherein at least one of said transparent electrodes comprises a glass

substrate coated with a transparent anode material.

39. The OLED of claim 38, wherein said transparent anode material is indium tin oxide.

42. An organic light emitting diode (OLED) comprising:

a single universal host that can be used for red, green and blue dopants having carrier transport properties.

43. The OLED of claim 42, wherein said universal host is doped with a red emitting material.

45. The OLED of claim 42, wherein said universal host is doped with a green emitting material.

47. The OLED of claim 42, wherein said universal host is doped with a blue emitting material.

The following claims, because they are considered to be allowable and are free of any objection or rejection, are presented below in rewritten, independent form:

4. An organic light emitting diode (OLED), comprising:

a single universal host that can be used for red, green and blue dopants for full color display, as specified by the CIE for red, green and blue dopants ;

a hole transporting layer;

an electron transport layer;

wherein said hole transporting layer and said electron transport layer are on opposing sides of said universal host and are in electrical contact with said universal host; wherein said universal host comprises an active emitting layer of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active portion; wherein at least one of said electrodes is transparent; wherein said universal host comprises 5,5'-bis(dimesitylboryl)-2,2'-bithiophene; and wherein said red emitting material is 6,13-diphenylpentacene.

6. An organic light emitting diode (OLED), comprising:

a single universal host that can be used for red, green and blue dopants for full color display, as specified by the CIE for red, green and blue dopants ;

a hole transporting layer;

an electron transport layer;

wherein said hole transporting layer and said electron transport layer are on opposing sides of said universal host and are in electrical contact with said universal host; wherein said universal host comprises an active emitting layer of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active portion;

wherein at least one of said electrodes is transparent; wherein said universal host material is 5,5'-bis(dimesitylboryl)-2,2'-bithiophene; and wherein said green emitting material is N,N'-diethylquinacridone.

8. An organic light emitting diode (OLED), comprising:

a single universal host that can be used for red, green and blue dopants for full color display, as specified by the CIE for red, green and blue dopants ;

a hole transporting layer;

an electron transport layer;

wherein said hole transporting layer and said electron transport layer are on opposing sides of said universal host and are in electrical contact with said universal host; wherein said universal host comprises an active emitting layer of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active

portion;

wherein at least one of said electrodes is transparent; wherein said universal host is doped with a blue emitting material; and wherein said hole transporting layer is 4,4-bis(1-naphthylphenyl-amino)biphenyl.

9. An organic light emitting diode (OLED), comprising:

a single universal host that can be used for red, green and blue dopants for full color display, as specified by the CIE for red, green and blue dopants ;

a hole transporting layer;

an electron transport layer;

wherein said hole transporting layer and said electron transport layer are on opposing sides of said universal host and are in electrical contact with said universal host; wherein said universal host comprises an active emitting layer of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active portion,

wherein at least one of said electrodes is transparent; and wherein said electron transport layer is 5,5'-bis(dimesitylboryl)-2,2'-bithiophene.

19. An organic light emitting diode (OLED), comprising:

a hole transporting layer ;

an electron transport layer that is also a single universal host that can be used for red, green and blue dopants ;

wherein said hole transporting layer and said electron transport layer are placed in series, and are in electrical contact with each other; wherein said hole transporting layer and said electron

transport layer together comprise an active portion of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active portion;

wherein at least one of said electrodes is transparent; wherein said electron transport layer is doped with a red emitting material; and wherein said red emitting material is 6,13-diphenylpentacene.

23. An organic light emitting diode (OLED), comprising:

a hole transporting layer ;

an electron transport layer that is also a single universal host that can be used for red, green and blue dopants ;

wherein said hole transporting layer and said electron transport layer are placed in series and are in electrical contact with each other;

wherein said hole transporting layer and said electron transport layer together comprise an active portion of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active portion;

wherein at least one of said electrodes is transparent; and wherein said hole transporting layer is 4,4-bis(1-naphthylphenyl-amino)biphenyl.

24. An organic light emitting diode (OLED), comprising:

a hole transporting layer ;

an electron transport layer that is also a single universal host that can be used for red, green and blue dopants ;

wherein said hole transporting layer and said electron transport layer are placed in series and are in electrical contact with each other;

wherein said hole transporting layer and said electron transport layer together comprise an active portion of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active portion;

wherein at least one of said electrodes is transparent; and wherein said electron transport layer is 5,5'-bis(dimesitylboryl)-2,2'-bithiophene.

32. An organic light emitting diode (OLED), comprising:

a hole transporting layer that is also a single universal host that can be used for red, green and blue dopants ;

an electron transport layer;

wherein said hole transporting layer and said electron transport layer are placed in series and are in electrical contact with each other; wherein said hole transporting layer and said electron transport layer together comprise an active portion of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active portion;

wherein at least one of said electrodes is transparent; wherein said red emitting material is 6,13-diphenylpentacene; and wherein said hole transporting layer is doped with a red emitting material.

36. An organic light emitting diode (OLED), comprising:

a hole transporting layer that is also a single universal host that can be used for red, green

and blue dopants ;

an electron transport layer;

wherein said hole transporting layer and said electron transport layer are placed in series and are in electrical contact with each other;

wherein said hole transporting layer and said electron transport layer together comprise an active portion of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active portion;

wherein at least one of said electrodes is transparent; and wherein said hole transporting layer is 4,4-bis(1-naphthylphenyl-amino)biphenyl.

37. An organic light emitting diode (OLED), comprising:

a hole transporting layer that is also a single universal host that can be used for red, green and blue dopants ;

an electron transport layer;

wherein said hole transporting layer and said electron transport layer are placed in series and are in electrical contact with each other;

wherein said hole transporting layer and said electron transport layer together comprise an active portion of said OLED;

electrodes on opposing sides of said active portion for providing a bias across said active portion;

wherein at least one of said electrodes is transparent; and wherein said electron transport layer is 5,5'-bis(dimesitylboryl)-2,2'-bithiophene.

44. An organic light emitting diode (OLED) comprising:

a single universal host that can be used for red, green and blue dopants having carrier transport properties wherein said universal host is a material adapted to emit at wavelengths in the blue visible light region or shorter and comprises 5,5'-bis(dimesitylboryl)-2,2'-bithiophene; wherein said red emitting material is 6,13-diphenylpentacene; and wherein said universal host is doped with a red emitting material.

46. An organic light emitting diode (OLED) comprising:

a single universal host that can be used for red, green and blue dopants having carrier transport properties; wherein said universal host material is 5,5'-bis(dimesitylboryl)-2,2'-bithiophene; and wherein said universal host is doped with a green emitting material N,N'-diethylquinacridone.

48. An organic light emitting diode (OLED) comprising:

a single universal host that can be used for red, green and blue dopants having carrier transport properties; wherein said hole transporting layer is 4,4-bis(1-naphthylphenyl-amino)biphenyl.

49. An organic light emitting diode (OLED) comprising:

a single universal host that can be used for red, green and blue dopants having carrier transport properties; wherein said electron transport layer is 5,5'-bis(dimesitylboryl)-2,2'-bithiophene.